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Social network conformity and construction work plan reliability

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ABSTRACT

In a large construction project delivery is usually handled by numerous subcontractors. Work plan reliability (WPR) of subcontractors is an essential element for improving project performance. Previous research mainly focused on the consequence of the WPR variability of a subcontractor on the following subcontractors in the project task-sequence. Construction industry lacks a good understanding of the social aspect of the subcontractors' WPR. Plausibly and arguably, construction subcontractors and their interactions/relationships in a project constitute a network, conceptualized as a "social network". "Social conformity" is one of the various social influence types that results in a change of performance/behavior in order to fit in a group. This research aims to understand how conformity plays a role in the subcontractors' performance particularly in their WPR. The objective of this paper is to develop an analytical approach to 1) demonstrate the impact of conformity on the WPR of subcontractors, and 2) identify the role of social network in conformity occurrence in a construction project. Two construction projects, each including a general contractor overseeing several subcontractors, were studied. Findings show that deviation from norms decreases as project proceeds. It also shows that the tendency of subcontractors to follow the norms of their neighborhood (local) is higher than their willing to follow the project norm (global). The research contributes to the body of knowledge as it proposes a social network based approach for the first time to explore how the subcontractors' WPR in a construction project can be under the influence of the conformity phenomenon. Understanding the subcontractors' manner can be useful for project managers when they need to establish a long-term working relationship with a particular subcontractor, or when they need to know much effort is necessary to spend on improvement initiatives of planning reliability.

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1. Introduction

In a large construction project where delivery is handled by numerous subcontractors (also referred by specialty trades) with different task packages a major challenge to project managers is how to keep the project on schedule [1–3]. The performance of a subcontractor can be impacted by the performance of other subcontractors during construction in various ways. For instance, when one subcontractor fails to complete a task based on the schedule, follow-on subcontractors in the task schedule are delayed in starting their portions of the project [2]. Or when two or more subcontractors are supposed to work in the same working area at the same time, there would be a potential of conflict due to inadequate working spaces or work area access, overcrowded jobsite, safety hazards, etc. and subsequently losing productivity [4–6].

The impact of subcontractors on each other is beyond the project task and space dependencies. It is not an uncommon situation that a subcontractor makes a decision based on the other subcontractors' behavior. For instance, when a subcontractor finds a project unreliable (for example when he/she sees that another subcontractor is not going to finish their tasks on time), there is little motivation for him/her to keep all the resources available on that particular project. Thus, he/she may decide to take his/her resources to another job. That is because subcontractors usually work on multiple projects simultaneously and they attempt to keep their workload at the maximum level in order to have a supply of available work and maximize profitability at any given time [2,3,7]. In many cases, they do not consider the interests of any other subcontractor and withhold true resource availability and scheduling information from the general contractor [7]. Unreliable work plans are the root cause of productivity loss [8–12]. Conversely, when there is enough reliability in the project work plan, the subcontractor is willing to keep its workforce available in the project.

In a construction project, there is usually no motivation (no reward or profit) for a subcontractor to have a better work plan reliability (WPR) than the other subcontractors. When a subcontractor finds other subcontractors make excuses to start or complete their tasks with delay and there is no strict punishment enforced by GC, he/she realizes that it is not urgent to make his/her best effort in completing the tasks on time based on the planned schedule. Thus, he/she learns from

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the other subcontractors to develop excuses for their tasks' delay and utilize the minimum possible resources for completing the tasks [3]. On the contrary, a subcontractor attempts to have a satisfactory level of reliability (i.e. start and complete the tasks on-time) when he/she finds all the other subcontractors perform their tasks nearly based on the planned time schedule. It is first because he/she finds the project profitable when he/she is able to rely on the reliability of the project work plan, so he/she attempts to be as reliable as the others to keep the project profitable for himself/herself. The second reason is that no one prefers to be the most unreliable party in the project for fear of being punished (or sued) by the GC or other subs. To summarize, it can be argued that a subcontractor usually decides to slow down or speed up their pace based on the observation of the other subcontractors' behavior and performance, and therefore, as the project proceed, he/she tries to sync up with the project norm.

Plausibly and arguably, construction subcontractors and their interactions and relationships in a project constitute a network, conceptualized as a "social network". A social network is a pattern of ties that exist between different actors, i.e. people, organizations, teams etc. [13]. Conformity, also known as herding behavior, is one of the influences of being in a social network. It refers to the tendency of changing behavior (or performance) in order to fit in a group and converge to the group norms [14]. The group norms emerge out of interaction with the others in the social network. A wide variety of research shows that the behavior of others in our social environment shapes our response to a situation. Indeed, watching others in the social network provides information about the normal behavior in a different novel or ambiguous situations [15,16].

The research pertaining to the impact of the social network on a construction project is still rather limited [17,18]. Although there has been a vast amount of research about the improvement of the subcontractors' performance, little has been written in the published literature about the social aspects of the subcontractors' relationship and interaction. This research aims to understand how conformity, as one of the important social network influences, plays a role in the subcontractors' performance particularly in their WPR. The objective of this paper is to develop an analytical approach to 1) demonstrate the impact of conformity on the WPR of subcontractors, and 2) identify the role of social network in conformity occurrence in a construction project. The results of two case studies are discussed to show the applicability of the proposed approach. The proposed approach, using conformity concept, first describes an outline for measuring the norms and deviation from the norm for the WPR of a construction project and then evaluates the statistical relationship between the deviation from norms and the WPR to identify the conformist/non-conformist subcontractors in the project. At the end, we compare the tendency of subcontractors to project norms (global) and neighborhood norms (local) to identify the role of subcontractor's neighbors (neighborhood) in the conformity level. The research contributes to the body of knowledge as it proposes a social network based approach for the first time to explore how the subcontractors' WPR in a construction project can be under the influence of the conformity phenomenon. The findings help construction project managers as it helps them to understand how the behavior of a subcontractor is under the influence of other subcontractors over the course of a project and how the subcontractors' WPR can be interpreted by the social network and conformity concept. It also helps them to identify the conformist and non-conformist subcontractors, so they can take proper actions toward improving the WPR norms for conformist subcontractors.

2. Research background

2.1. Social network analysis in construction

Social Network Analysis (SNA) investigates the interactions, relations and interrelationships of a set of actors (nodes) with the goal of examining structures of human groups, communities or a society by investigating t [13,19]. SNA, introduced by Moreno [20], has been applied to many research fields (such as aerospace, automotive bodies, and computer science) while classic SNA research has concentrated on sociological networks [19]. Recently, construction engineering and management researchers implement the social sciences for the interpretation of issues related to construction [18]. Wambeke et al. [11] believed that recognition of the underlying network of trades in a construction project can contribute to project success. Understanding the jobsite social network can help the construction site managers to coordinate the trades effectively and succeed in the challenging environment of a project; however, achieving this skill takes years of experience and few superintendents could articulate it [11,22].

Applications of SNA in construction project management research are diverse, but mostly focused on the project team information exchange and communication. Chinowski et al. [21], using SNA, focused on the alignment of actual stakeholder knowledge exchange to assess project effectiveness. Park et al. [19] implemented SNA to investigate the formation and impact of construction firms' collaborative networks for performing international projects. Dogan et al. [23] assessed the coordination performance of a construction project based on the centrality measures of e-mail communication network.

The research pertaining to the jobsite social network, where actors are specialty trades/subcontractors of the project and two subcontractors are connected (have a relationship) in the network if they physically work in the same area(s) at the same time, is very limited. Wambeke et al. [11] provided a detailed description of the steps to create a social network of trades and outlined a procedure to identify the organizational social network of construction trades and determine its key members. Wambeke et al. [22] determined the causes of variation that pose the greatest risk of impacting project performance, then analyzed the social network of trades to develop a decision support system to target trades in an effort to reduce variation. Abbasian-Hosseini et al. [24,25] proposed a social network-based data envelopment analysis (DEA) benchmarking procedure (SDBP), which combines DEA (assessing the relative efficiency of DM units) and SNA to identify the benchmarks for the inefficient specialty trades (STs). They also used social network analysis to examine how the existing interference potential among the specialty trades is related to their work plan reliability over the course of the project [26]. Lin [27], analyzing job-site social networks, found that the order-management network has the highest degree of social density. Priven and Sacks [28] explored how Last Planner system strengthens the project social network by building relationships among construction teams.

2.2. Construction subcontractors/trades' work plan reliability (WPR)

A reliable work plan is characterized by a high fulfillment of planned work. Lean Construction defines plan reliability as the extent to which a plan is an accurate forecast of future events, measured by Percent Plan Complete (PPC). PPC, defined as the number of planned activities completed divided by the total number of planned activities (expressed as a percentage), is a basic measure of how well the planning system is working. PPC analysis can help to diminish the risk of variability propagation to downstream flows and tasks [29]. WPR is an essential element for improving project performance [30,31]. Previous research showed that improving the WPR will result in project productivity increase. Thomas et al. [31] examined whether improving the reliability of work flow improve the construction productivity. They concluded that the more effort devoted to improving the WPR affects cost and schedule performance positively. González et al. [30] conducted a research to understand how changes in WPR levels impact the project performance during the construction phase. They, through statistical analysis, confirmed that performance will improve when WPR improves. Last Planner System, one of the lean construction scheduling approaches

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